GRAVITY AND AEROSTATIC PRESSURE ON FAST SHIPS AND AIRPLANES

The latest issue of the Meteorological Office Circular, No. 42, December 1, 1919, contains an interesting note on the Behavior of Marine Barometers on board fast ships. The views expressed are based on certain experiments made by Professor Duffield upon the value of gravity at sea. In his work it became necessary to study carefully the variations of pressure recorded by a mercury barometer of the new type under different conditions of ship motion.

It has been suspected for a long time that on fast ships and in strong winds, pressure readings might be considerably influenced by eddy action.

The experiments in this case were carried out on H.M.S. *Plucky,* a destroyer. Steaming at 22 knots against a head wind of about 12 m/s., the barometer showed a fall of 1.2 kilobars compared with the reading when going with the wind. This is an aspiration effect and will vary with the location of the instrument aboard the ship. Three barometers were used and the change in the cabins was only 0.4 kb. The fall is sudden and unless the navigating officer is posted might be taken as an indication of impending change in weather. It is stated that opening or closing doors and ports did not materially affect the readings but this we are disposed to question since it has long been known that very noticeable aerostatic pressure variations occur during high winds on opening or shutting doors and windows. At Blue Hill Observatory using large and sensitive barographs with fast moving record sheets we have obtained variations of from 3 to 5 kbs. The location of the opening determines the character of the change; windward openings cause a rise, leeward ones, a fall.

This brings home the necessity of correcting the records of fast ships and it would be especially interesting if our Hydrographic Office would furnish open scale barographs to fast ships and analyze the variations in aerostatic pressure when such vessels were encountering high winds ahead or astern. If our ships and planes could also carry pressure tube anemometers of the Dines's pattern or the modified form provided for the Navy, records showing to a nicety gustiness and relation of speed to pressure would be available.

The next interesting feature of these experiments is the deduction that a ship moving east and therefore travelling *with* the earth's rotation experiences a consequent increase in the centrifugal tendency, resulting in a slight decrease in the value of gravity as indicated by a mercurial barometer. A west-bound ship, on the other hand, would show an apparent increase. This was put to test on the *Plucky* and it was found that

> on a west course the mercury barometer when compared with an aneroid stood relatively higher than when on an east course, indicating that the mercury weighs less because a longer column is needed to give the same pressure. For a speed of 22 knots the difference amounted to approximately 0.2 kb.
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> Since bodies travelling east are lighter than when they are travelling west, we expect to find (other things being equal) a west wind above an east wind, a shell fired east with a longer range than when fired west, and an airship going east with a larger carrying capacity than when flying west. H. M. S. *Plucky* weighed about 4 cwt. less on an east course than when steaming west.

Professor Edward V. Huntington in Science, January 9, 1920, p. 45, shows that a body moving westward at high speed requires an increase in the supporting force.

Dr. Carl Herring in the same issue discusses the possibility of moving a mass so rapidly that the net weight would be zero.

Aerographers of course are familiar with the equation on which the above reasoning for gravity rests, namely $2\omega v \cos \phi \sin \alpha$. In this, ω is the angular velocity of the earth's rotation, that is $2\pi/86164$ seconds or .00007292 radians per second; v, the velocity of the ship in meters per second, ϕ, the latitude and α the deviation from true north or south, of the ship's course. Dr. Duffield gives this value for latitude 50° N. as .005 kb. per knot.

Another matter under discussion is the effect of the ship's vibration due to engines upon the sensitiveness of the barograph record. At present it can be said that on a vi-

brating ship the lag of the instrument is much reduced.

All of the above applies with even more force to airships. Deflective influence will modify the course not only in a horizontal but also in a vertical plane. Professor Marvin has shown that when a machine is climbing with given power, the ascent will be more rapid if made clockwise than when counterclockwise; this of course for the northern hemisphere, and conversely in the southern. So the aviator must watch his barometer not less than his compass. With him it is all important that true static pressures be recorded; and at least he should be keenly alive to the importance of the corrections to be applied, most of them functions of speed. When an aneroid is moving at 45 m/s (100 miles an hour) not an unusual speed, he may be called upon to add to or subtract from his proper speed, the air speed, say 25 m/s., also the earths angular velocity.

The exposure of the barograph *is* important. The containing box must have an opening either facing the wind or away from it: if the former, the pressure shown is aerostatic plus aerodynamic. Zahm and others have discussed pressure distribution around a steamlike body and J. G. Coffin has actually designed and used a container that rotates periodically. He found that when the aperture was 45° either side of the head-on position the observed pressure was normal or true static.

From all the above, it is evident that hereafter in the charting and discussion of storm centers at sea, as based on pressure readings, we must know *whether the ships were headed east or west, the angle of inclination of the ship to the wind, the speed of the ship and the speed, direction and gustiness of the wind.*

ALEXANDER MCADIE

BLUE HILL OBSERVATORY,
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STATE REWARDS FOR MEDICAL DISCOVERIES

A REPORT has been issued by a joint committee of the British Medical Association and of the British Science Guild, which has been considering the question of awards for medical discoveries. According to the abstract in the *Journal* of the American Medical Association the committee defines medical discoveries as being: (1) the ascertainment of new facts or theorems bearing on the human body in health and on the nature, prevention, cure or mitigration of injuries and diseases; (2) the invention of new methods or instruments for the improvement of sanitary, medical and surgical practise, or of scientific and pathologic work. The reasons given for rewarding medical discoveries are the encouragement of medical investigation and the discharge of a moral obligation incurred by the public for its use of private effort. The various public types of rewards are cited as; titles and honors given by the state, by universities and other public bodies; prizes and medals; patents; promotion and appointments; pecuniary rewards by the state. Concerning the general principle of assessment, the committee hold that, in the interests of the public, all medical discoveries should if possible receive some kind of acknowledgment or recompense. But in view of the variable conditions, nature and effects of particular investigations, it will often be difficult to assess the kind of recompense suitable. In the first place, a distinction should be drawn between compensation and reward. By compensation is meant an act of justice done to reimburse losses; by reward an act of grace in appreciation of services. The following different cases should be considered: A. Discoveries involving pecuniary or other loss either by direct monetary sacrifice or by expenditure of time, or by diminution of professional practise, without corresponding pecuniary gains. An example is that of Jenner, who occupied himself so closely with the investigation of vaccination that he lost most of his medical practise and also a considerable sum in expenses. This was fully acknowledge by Parliament, which granted him $150,000. B. Discoveries that have increased the professional emoluments of the investigator by enhanced practise or other means.